Heliyon 10 (2024) e31088

Contents lists available at ScienceDirect

Heliyon

journal homepage: www.cell.com/heliyon

Research article

# Capsule closure has better hip function than non-closure in hip arthroscopy for femoracetabular impingement: A systematic review and meta-analysis

Yang Lv[a,1], Meiping Yang[b,1], Cheng Hu[c], Da Guo[a], Caiqiong Zhao[a], Li Wei[a], Shuchai Xu[a], Dingkun Lin[a], Weiming Yang[a,*]

[a] *Department of Orthopedics, The Second Affiliated Hospital of Guangzhou University of Chinese Medicine, Guangzhou, Guangdong, China*
[b] *The Second Clinical Medical College, Guangzhou University of Chinese Medicine, Guangzhou, Guangdong, China*
[c] *Department of Orthopaedics, Guangzhou Orthopedic Hospital, Guangzhou University of Chinese Medicine, Guangzhou, Guangdong, China*

A R T I C L E I N F O

*Keywords:*
Hip arthroscopy
Capsular closure
Femoracetabular impingement
Meta-analysis

A B S T R A C T

*Background:* The impact of capsular closure vs non-closure in hip arthroscopy for femoracetabular impingement (FAI) was assessed by a meta-analysis.
*Methods:* With the most recent search update occurring in August 2022, relevant studies were found by searching the Pubmed and EMBASE databases. A collection of studies was made that conducted hip arthroscopy for FAI. Review Manager 5.3 was used to carry out the meta-analysis. The dichotomous and continuous factors were compared using the odds ratios (OR) and mean differences (MD). A fixed-effect or random-effect model was chosen, depending on the degree of heterogeneity ($I^2$). Forest plots were used to assess the results. A significance level of $P < 0.05$ was applied to the statistical analysis.
*Results:* Ultimately, 15 studies were incorporated into the meta-analysis. The surgery time was longer for the capsular closure group (CC group) compared to the non-closure (NC group) group. ($P < 0.001$, SMD = 8.59, 95%CI [7.40, 9.77], $I^2 = 32$ %). Following hip arthroscopy, the CC group's mHHS was superior to that of the NC group ($P = 0.001$, MD = 2.05, 95%CI [0.83, 3.27], $I^2 = 42$ %), HOS-ADL ($P < 0.001$, MD = 4.29, 95%CI [3.08, 5.50], $I^2 = 0$ %). The capsular closure group had a reduced rate of postoperative complications ($P = 0.001$, OR = 0.21, 95%CI [0.08, 0.54], $I^2 = 0$ %) and conversion to THA ($P = 0.01$, OR = 0.42, 95%CI [0.21, 0.83], $I^2 = 0$ %) following hip arthroscopy than the non-closure group. The revision rate, VAS, and postoperative HOS-SSS did not significantly differ between these two groups ($P > 0.05$).
*Conclusion:* The current meta-analysis found that the closed group had a lower complication rate and considerably greater mHHS and HOS-ADL following surgery compared to the non-closed capsule group. Whether this is related to the continuous progress of biomechanical and clinical research techniques deserves our attention.
*Level of evidence:* Level IV, systematic review of Level I through Level III studies.

* Corresponding author.
*E-mail address:* yangweimingguke@126.com (W. Yang).

[1] These authors contributed to the work equally and should be regarded as co-first authors.

https://doi.org/10.1016/j.heliyon.2024.e31088
Received 19 August 2023; Received in revised form 9 May 2024; Accepted 9 May 2024
Available online 13 May 2024
2405-8440/

## 1. Introduction

Femoracetabular impingement (FAI) is one of the main causes of hip pain in adults which occurs when the abnormal morphology and structure of the femoral head-neck junction and acetabular result in chronic impingement then acetabulum labral tear [1]. With the development of arthroscopic technology and the in-depth study of FAI, the efficacy of hip arthroscopic treatment of FAI has been confirmed. Surgeons may use a “T” incision or even an excision of the capsule for better exposure. Previous research has demonstrated that the bone mostly determines the stability of the hip joint, so the capsule incision is typically not healed [2]. The soft tissues surrounding the hip joint, particularly the hip capsule, have been found to have a role in preserving the stability of the hip joint in recent years as our understanding of the biomechanics of the hip joint has grown. Among the three ligaments formed by the thickening of the joint capsule, iliofemoral ligament is the strongest, which primarily controls the forward movement of the hip joint as well as its external rotation. Incision of the capsule can damage the iliofemoral ligament, which inevitably affects the stability of the hip joint [3]. In addition, it may impact other functions of the hip capsule, including the sealing of the joint, the provision of proprioception, and the perception of pain.

However, the effect of routine repair of joint capsule incisions is still controversial. Some studies have shown that routine repair of joint capsule incisions does not significantly increase postoperative hip joint function and satisfaction in patients [4]. So it is early thought that FAI with stable joints does not need a suture of the capsule, which could shorten the operation time. With the advancement of hip arthroscopic surgery and the refinement of treatment for hip arthroscopic patients [5], more and more doctors are gradually paying attention to hip capsule suturing technology and conducting high-quality RCT long-term follow-up studies, indicating that routine repair of joint capsule incisions is beneficial for the long-term treatment of hip joint surgery. To provide certain references for clinical treatment, we conducted this Meta-Analysis to compare the therapeutic effect of repairing the capsule. We hypothesize that routine repair of joint capsule incisions in hip arthroscopy is beneficial for improving postoperative hip joint function scores and does not increase the incidence of postoperative complications.

## 2. Materials and methods

### *2.1. Search strategy*

Two writers conducted searches in PubMed, EMBASE, Medline, Springer, SinoMed, and CNKI until August 2022 in order to find pertinent publications for the purpose they had set out. The search strategies were: ((((((Hips) OR Coxas) OR Coxa) OR Hip)) AND (((((Arthroscopy) OR Arthroscope) OR Arthroscopic) OR Arthroscopies))) AND ((((((((FAI) OR Femoroacetabular impingement) OR Impingements, Femoracetabular) OR Impingement, Femoracetabular) OR Impingement, Femoro-Acetabular)) AND (((((capsular) OR capsules) OR capsulars) OR capsule)). While seeking the key words, the mesh terms were combined with free terms. The authors thoroughly examined the full-text papers that satisfied the inclusion criteria and retrieved pertinent results for a thorough analysis, in accordance with the inclusion and exclusion criteria that precisely met the population, intervention, comparison, outcome (PICOS), and study design. August 2022 marked the determination of all included studies.

## 3. Criteria for inclusion and exclusion

Inclusion:

1. Study design: All observational studies (CS and CCS) as well as RCT and nRCT were suitable for inclusion.
2. Language: If a study was published in English, it was included in this systematic review.
3. Population: patients with FAI.
4. Intervention: Patients undergoing the same procedure with capsular repair (plication, total repair, partial repair) were included in the capsule-closure group.
5. Control: Patients with unrepaired capsulotomy (T-capsulotomy, limited or extended section) for FAI were included in the non-closure group.
6. Outcomes: time of surgery, amount of revisions, amount of complications, amount of conversion to THA, Hip Outcome Score–-Sport-Specific Subscale, Hip Outcome Score–Activities of Daily Living, Visual Analogue Scale, and modified Harris Hip Score.
7. Definition: The term “capsular repair” was used to refer to the partial, complete, or complicated repair of a capsule. Unrepaired capsulotomy is the term used to describe capsules from patients with hip capsulotomies (T-capsulotomy, limited or extended section) without any repairs.

Exclusion criteria:

1. Study type: Reviews, opinion-based publications, case reports and technique reports were also eliminated.
2. Language: Texts written in languages other than English, and texts without an abstract were also removed.
3. Population: Patients with broad focal or neuromuscular issues, synovial chondromatosis, global morphologic anomaly requiring surgical dislocation, inflammatory hip illnesses, Legg-Calvé-Perthes disease, and Avascular necrosis were excluded from this study as well.

4. Intervention: Microsoft Excel was used to organize the data from all of the included research. The data contained the following: author, title, journal, publication date, study design, quantity of patients, average follow-up, and result ratings.

### *3.1. Data extraction*

Microsoft Excel was used to organize the data from all of the included research. The data contained the following: title, author, journal, publication date, study design, number of patients, demographics, average follow-up, and result ratings. Capsular repair and section or T-capsulotomy were among the recorded surgical procedures (plication, full repair, or partial repair).

### *3.2. Quality assessment*

Two reviewers evaluated the methodological quality of every included paper. The Newcastle-Ottawa Scale (NOS) was used to grade all case-control studies (CCS), and the Modified Cochrane Risk of Bias Tool 2.0 (ROb2.0) was used to rate –randomized controlled trials (RCTs). When there was a disagreement, both raters decided on a consensus score for the final rating. Interobserver dependability was also confirmed. Two autonomous researchers evaluated the incorporated study's quality by utilizing ROB and NOS.

NOS is a method that is frequently used to evaluate the caliber of cohort and case-control studies. Three modules totaling eight items are used to evaluate case-control studies: selection, comparability, and exposure evaluation. We assess the suitability of the case definition, the cases' representativeness, the selection of controls, and the definition of controls in the selection phase. The comparability of cases and controls is evaluated in the comparability section based on the design or study. We validate the exposure assessment by using the same methodology for both cases and controls, as well as by looking at the non-response rate.

We rated outcomes of interest as 1) low risk of bias; 2) probably low risk of bias; 3) probably high risk of bias; or 4) high risk of bias for the ROb2.0 assessment. These ratings covered the following domains: bias resulting from the randomization process; bias resulting from deviations from the planned intervention; bias resulting from incomplete outcome data; bias resulting from inaccurate outcome

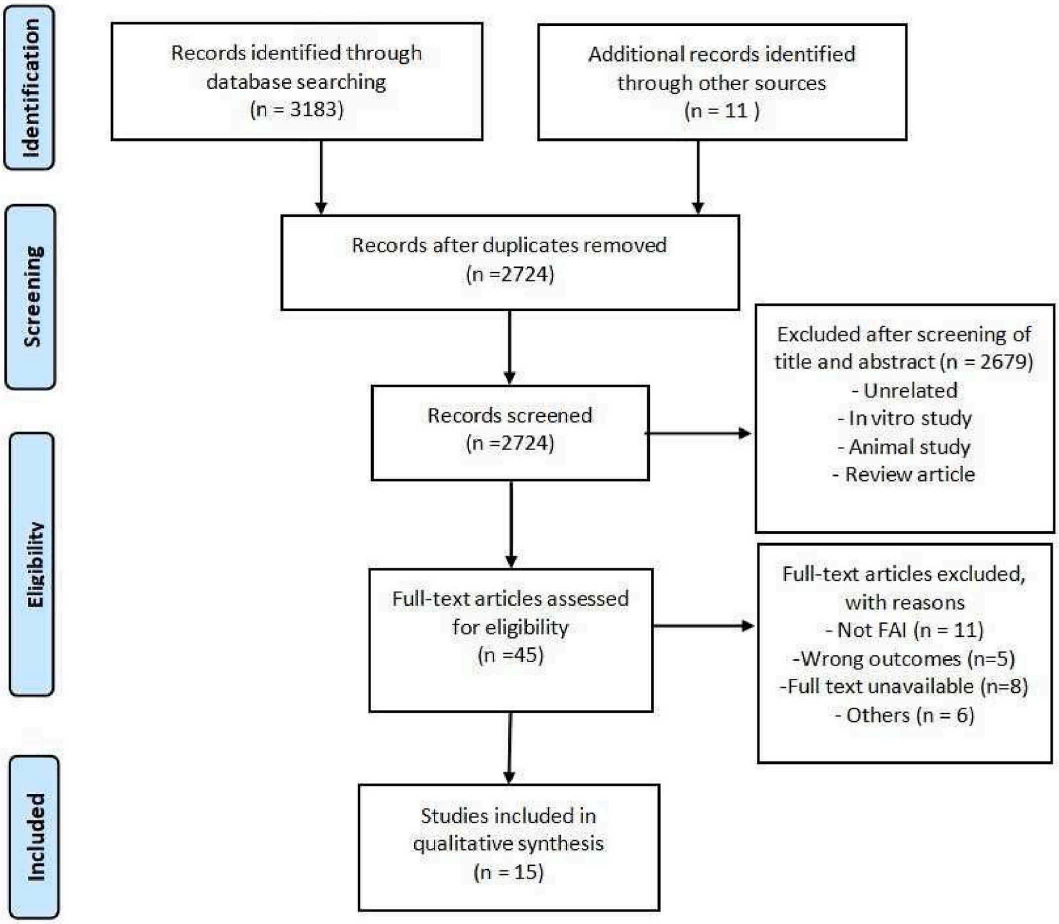


**Fig. 1.** Demonstration of the flowchart for the studies that were chosen for inclusion in the meta-analysis.

**Table 1**
Based characteristics of the included studies.

| Studies | Study design | Region | Treatment group | Control group | Number TG/CG | Age TG/CG | Follow-up(M) TG/CG | Outcome | MINORS score | GRADE assessment |
|---|---|---|---|---|---|---|---|---|---|---|
| Domb 2012 [6] | CCS | USA | capsular repair | Unrepaired capsule | 168/235 | 29.4 ± 12.4/42.3 ± 12.4 | 24 | ②③④⑤⑥ | 20 | 2b |
| Amar 2014 [7] | CCS | USA | capsule Closed | Capsule Open | 50/50 | 38.2 ± 1.96/36.7 ± 2.27 | 13.2/12.1 | ①⑥ | 22 | 2b |
| Frank 2015 [8] | CCS | USA | complete capsular repair | Partial capsular repair | 32/32 | 32.7 ± 10.2/32.9 ± 9.8 | 29.9 | ①②③⑤⑥⑦ | 18 | 2b |
| Bolia 2018 [9] | CCS | USA | capsular closure | No capsular repair | 50/50 | 36(14–77)/36 (14–77) | 5 | ②③⑧ | 16 | 2b |
| Domb 2018 [10] | CCS | USA | repaired Capsule | Unrepaired capsule | 65/65 | 36.8 ± 12.4/37.7 ± 12.6 | 64.8/75.7 | ②③④⑤⑥⑦ | 18 | 2b |
| PAN 2019 [11] | RCT | China | capsular closure | Non-capsular closure | 30/30 | 37.2 ± 10.72 | 12 | ②④ | NA | 1b |
| Atzmon 2019 [12] | CCS | Israel | capsular closure | Non-capsular closure | 35/29 | 38.1 ± 2.83/37.6 ± 2.35 | 40.4/60.7 | ①②③ | 20 | 1b |
| Bolia 2019 [13] | CCS | USA | capsular repair | No capsular repair | 84/42 | 38 ± 15 | 60 | ②③⑥⑦ | 20 | 2b |
| CHEN 2019 [14] | CCS | China | capsular repair | No capsular repair | 38/64 | 37.6 ± 11.1/38.6 ± 11.3 | 12 | ①②③⑤ | 16 | 2b |
| Filan 2020 [15] | CCS | Ireland | capsular Closure | No capsular repair | 458/508 | 27.6 ± 6.9/28.5 ± 7.2 | 48 | ②⑥⑦ | 20 | 2b |
| Economopoulos 2020 [16] | RCT | USA | complete Capsular | No capsular repair | 46/45 | 35.2 ± 10.9/36.4 ± 13.5 | 24 | ②③⑦ | NA | 1b |
| Hassebrock 2020 [17] | CCS | USA | capsular Closure | No–capsular closure | 62/49 | 18.6 ± 3.8 | 48 | ②③⑥⑦ | 20 | 1b |
| Thaunat 2020 [18] | CCS | France | capsular Closure | No capsular repair | 25/39 | 28.5 ± 8.2 | 34.17 | ②⑤ | 18 | 2b |
| Bech 2021 [19] | RCT | Netherlands | capsular repair | No capsular repair | 56/53 | 33.5 ± 8.5/35.5 ± 10.4 | 12 | ⑤ | low | 1b |
| Sugarman 2021 [20] | RCT | USA | capsular repair | No capsular repair | 26/26 | 31.8 ± 8.6 | 24 | ②③④⑤ | low | 1b |

Note: RCT: randomized controlled trial; CCS: case-control study. Outcomes including: ①surgery time; ②mHHS; ③HOS; ④VAS; ⑤complication; ⑥revision; ⑦conversion to THA.

assessment; and bias resulting from the selection of the published outcomes, including alterations from the recorded protocol.

### 3.3. Statistics

Using RevMan 5.3 software, the studies were statistically analyzed. The mean difference (MD) in the case of continuous data and the odds ratio (OR) in the case of dichotomous data were both utilized as useful indices, and 95 % confidence intervals (CI) were produced and evaluated. In cases where studies showed statistical homogeneity ($P > 0.05$, $I^2 < 50$ %), a fixed-effects model was employed for the meta-analysis. In addition, the source of any statistical heterogeneity ($P < 0.05$, $I^2 \geq 50$ %) in the results was examined; for the sensitivity analysis, one study was eliminated from each iteration to ascertain whether the results demonstrated the stability of the full analysis's conclusions. For the meta-analysis, a random-effects model was employed where there was no clinical heterogeneity.

## 4. Result

### 4.1. Study characteristics

Using database searches, a total of 3183 relevant trials were found. 11 studies were identified through other sources. 470 studies were eliminated after repetitive literature was filtered out. After excluding irrelevant research, in vitro studies, animal studies, and review articles from the titles and abstracts, a total of 2647 papers were eliminated. After that, we eliminated thirty articles according to the inclusion criteria. Ultimately, 15 studies [6–20] were included in the meta-analysis. The flow diagram for the included research is displayed in Fig. 1. There were 2542 FAI patients in total who had hip arthroscopy; 1225 patients were in the treatment group (capsular closure group) and 1317 patients had surgery with hip arthroscopy with no capsular closure (control group). Tables 1 and 2 display the primary attributes of the identified studies.

### 4.2. Quality assessment

Among the CCS studies, we assessed the quality using NOS evaluation criteria. Four studies did not report Non-Response rate and scored 6 points, the other seven studies scored 7 points. All the studies select the hospital controls.

To make simpler the overall guidance and offer more specific help on rating the risk of bias for areas with more judgment-based

**Table 2**
Arthroscopic technique and capsular closure method of the included studies.

| Studies | Arthroscopic approach | Capsulotomy length and position | Capsulotomy method | Capsular closure method |
|---|---|---|---|---|
| Domb 2012 [6] | AP and MAP | NA | Interportal capsulotomy | A side-to-side technique, with three or more capsular sutures |
| Amar 2014 [7] | AP and MAP | NA | Interportal capsulotomy | A side-to-side technique with two polydioxanone (PDS) sutures |
| Frank 2015 [8] | AP and MAP | NA | Interportal capsulotomy | A side-to-side technique with multiple absorbable sutures |
| Bolia 2018 [9] | AP and MAP | Length is 2.5 cm | Interportal capsulotomy | Intermittent suture with two absorbable (Vicryl no. 2) sutures |
| Domb 2018 [10] | AP and MAP | NA | Interportal capsulotomy | A side-to-side technique, with three or more capsular sutures |
| PAN 2019 [11] | AP, MAP, and ALP | The 11- and 3-o'clock positions, the length is NA | T-capsulotomy | A side-to-side technique using Multiple Arthrex High strength lines |
| Atzmon 2019 [12] | AP and MAP | NA | Interportal capsulotomy | A side-to-side technique with two absorbable (Vicryl no. 2) sutures |
| Bolia 2019 [13] | AP and MAP | Length is 2.5 cm | Interportal capsulotomy | A side-to-side technique with two absorbable (Vicryl no. 2) sutures |
| CHEN 2019 [14] | AP and MAP | NA | Interportal capsulotomy | A side-to-side technique with multiple stitches and absorbable (Ethibond no. 2) sutures |
| Filan 2020 [15] | AP and MAP | NA | Interportal capsulotomy | A side-to-side technique with multiple braided polyblends and nonabsorbable sutures (1–4 number of sutures) |
| Economopoulos 2020 [16] | AP, MAP, and ALP | Length is 4-cm or 5.5-cm | Interportal capsulotomy | A side-to-side technique with multiple absorbable sutures (No. 2 FiberWire (Arthrex)) |
| Hassebrock 2020 [17] | AP, MAP, and ALP | Length is 4-cm or 5.5-cm | Interportal capsulotomy | A side-to-side technique with three absorbable sutures (No. 2 FiberWire (Arthrex)) |
| Thaunat 2020 [18] | AP, MAP, and ALP | Length is 1 cm | Outside-in capsulotomy | A side-to-side technique with two absorbable sutures (No. 2) |
| Bech 2021 [19] | AP, MAP, and ALP | NA | Interportal capsulotomy | A side-to-side technique with two or three absorbable sutures (No. 2) |
| Sugarman 2021 [20] | AP and MAP | For the 11- and 3-o'clock positions, the length is NA | Interportal capsulotomy | A side-to-side technique with multiple absorbable sutures |

Note: AP, the anterior portal; ALP, the anterolateral portal; MLP, midanterior portals; DALA, Distal Anterolateral approach.

**Table 3**
Quality assessment of CCS studies.

| Item Study | Selection | | | | Comparability | Exposure | | | Score |
|---|---|---|---|---|---|---|---|---|---|
| | Is the case definition adequate? | Representativeness of the cases | Selection of Controls | Definition of Controls | Comparability of cases and controls on the basis of the design or analysis | Ascertainment of exposure | The same method of ascertainment for cases and controls | Non-Response rate | |
| Domb 2012 | ☆ | ☆ | b[1] | ☆ | ☆ | ☆ | ☆ | b[2] | 6 |
| Amar 2014 | ☆ | ☆ | b[1] | ☆ | ☆ | ☆ | ☆ | ☆ | 7 |
| Frank 2015 | ☆ | ☆ | b[1] | ☆ | ☆ | ☆ | ☆ | ☆ | 7 |
| Bolia 2018 | ☆ | ☆ | b[1] | ☆ | ☆ | ☆ | ☆ | b[2] | 6 |
| Domb 2018 | ☆ | ☆ | b[1] | ☆ | ☆ | ☆ | ☆ | b[2] | 6 |
| Atzmon 2019 | ☆ | ☆ | b[1] | ☆ | ☆ | ☆ | ☆ | ☆ | 7 |
| Bolia 2019 | ☆ | ☆ | b[1] | ☆ | ☆ | ☆ | ☆ | ☆ | 7 |
| CHEN 2019 | ☆ | ☆ | b[1] | ☆ | ☆ | ☆ | ☆ | b[2] | 6 |
| Filan 2020 | ☆ | ☆ | b[1] | ☆ | ☆ | ☆ | ☆ | ☆ | 7 |
| Hassebrock 2020 | ☆ | ☆ | b[1] | ☆ | ☆ | ☆ | ☆ | ☆ | 7 |
| Thaunat 2020 | ☆ | ☆ | b[1] | ☆ | ☆ | ☆ | ☆ | ☆ | 7 |

Note: b[1] represents hospital controls; b[2] represents non respondents described.

characteristics, we adapted the Cochrane ROB 2.0 for the RCT trials. Table 3 and Fig. 2 display the study's quality assessment.

## 5. Outcomes of meta-analysis

### *5.1. Surgery time*

With 262 patients, four studies [7,11,12,14] reported the amount of time spent on hip arthroscopy in the CC group and NC group. Fig. 3 displays the results of the meta-analysis. The findings showed that the capsular closure group's operation took longer than the non-closure group's. (SMD = 8.59, 95%CI [7.40, 9.77], $I^2 = 32$ %, $P < 0.001$).

### *5.2. Modified Harris Hip Score*

The mHHS following hip arthroscopy in the CC group and the NC group, which included 1996 patients, were published in ten studies [6,8,10–12,14–16,18,20]. Fig. 4 displays the results of the meta-analysis. The findings indicated that following hip arthroscopy, the capsular closure group's mHHS scores were superior to those of the non-closure group. (MD = 2.05, 95%CI [0.83, 3.27], $I^2 =$ 42 %, $P = 0.001$). According to the subgroup analysis, nRCT studies show great mHHS scores in the capsular closure group.

### *5.3. Hip outcome score (HOS)*

With 920 patients, Seven studies [8–10,13,14,16,20] reported the HOS-ADL after hip arthroscopy in the CC group and the NC group. Fig. 5 displays the results of the meta-analysis. The CC group's HOS-ADL after surgery was superior to the non-closed group's. (MD = 4.29, 95 % CI [3.08, 5.50], $I^2 = 0$ %, $P < 0.001$).

Following hip arthroscopy, the HOS-SSS ratings for the CC group and the NC group were reported in Six studies [6,8,9,13,16,20], totaling 836 patients. Fig. 6 displays the results of the meta-analysis. Postoperative HOS-SSS score showed no difference in the closed and non-closed group. (MD = 2.71, 95 % CI [−3.69, 9.10], $I^2 = 61$ %, $P = 0.41$).

### *5.4. Visual Analogue Scale (VAS)*

Five studies [6,10,11,19,20] reported the scores of postoperative VAS in the treatment group and the control group, including 754 patients. As shown in Fig. 7. The findings suggested that there was not a significant variance in the two groups' postoperative VAS scores. ($P = 0.29$,MD = −0.15, 95 % CI [−0.44, 0.13], $I^2 = 13$ %).

### *5.5. Complication*

With 413 patients, Seven studies [8,10,12,14,17,18,20] reported the postoperative complication rate in the treatment group and the control group. As shown in Fig. 8. The results demonstrated that the closed group had a reduced postoperative complication rate than the non-closed group. ($P = 0.001$,OR = 0.21, 95 % CI [0.08, 0.54], $I^2 = 0$ %).

### *5.6. Revision*

With 715 patients, Five studies [10,13,15–17] reported the postoperative revision rate in the treatment group and the control

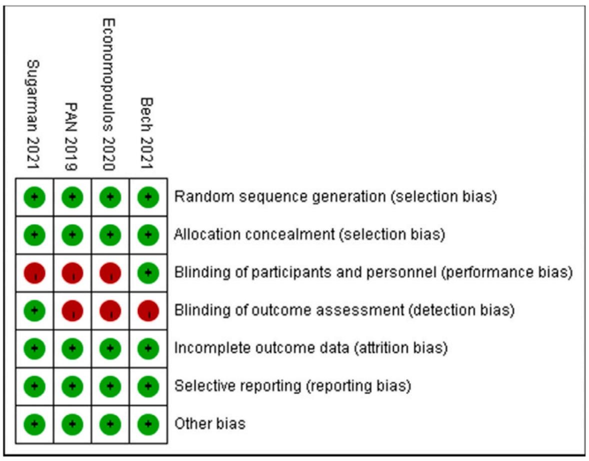


**Fig. 2.** Evaluation of RCT study quality.

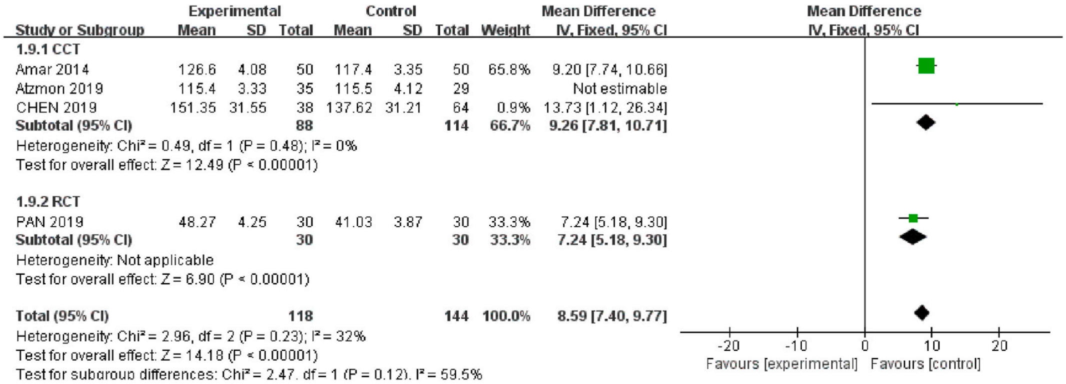


**Fig. 3.** Meta-analysis result of surgery time.

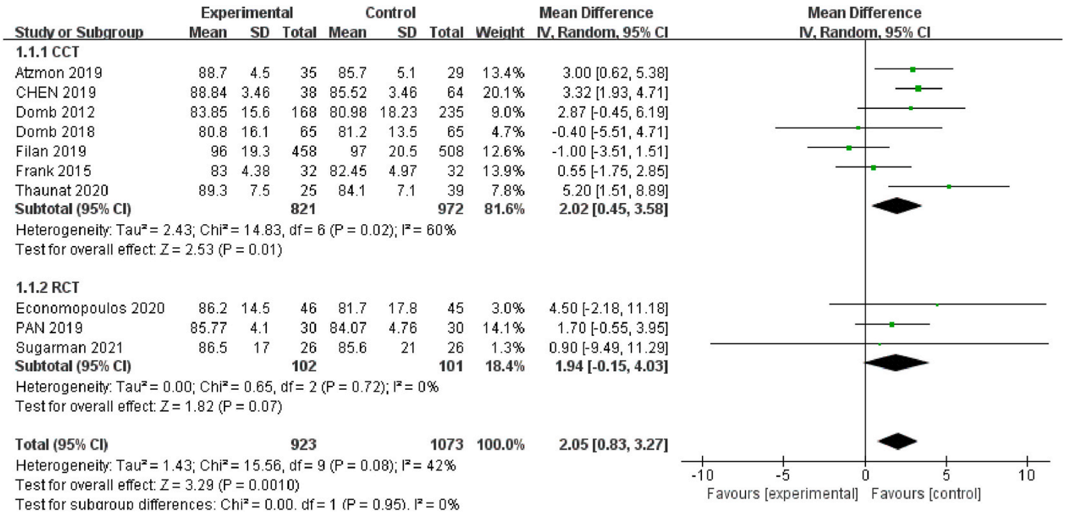


**Fig. 4.** Meta-analysis result of mHHS.

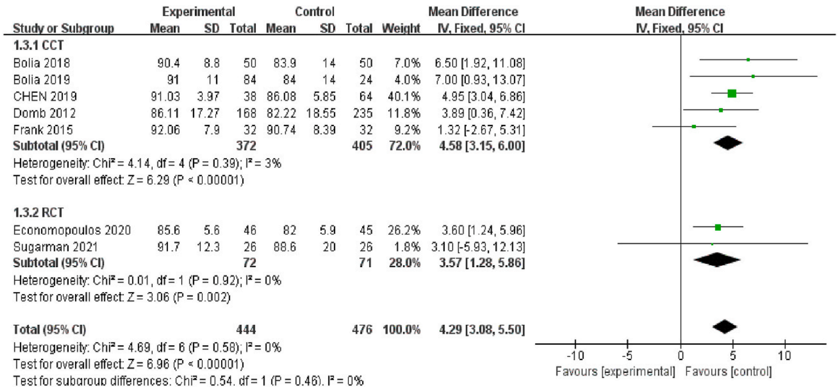


**Fig. 5.** Meta-analysis result of HOS-ADL.

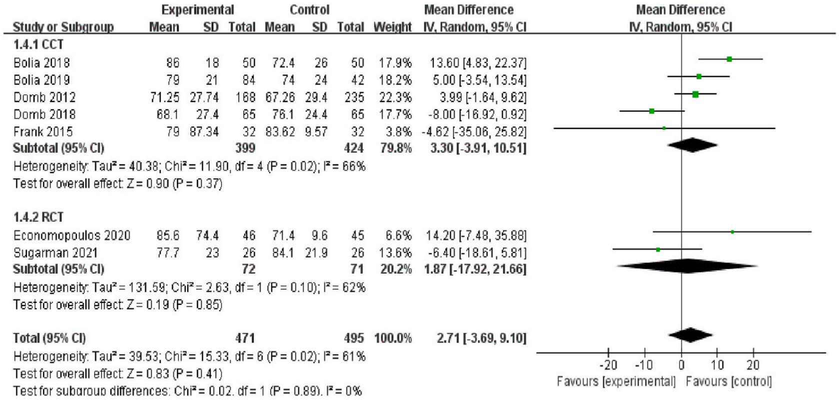


**Fig. 6.** Meta-analysis result of HOS-SSS

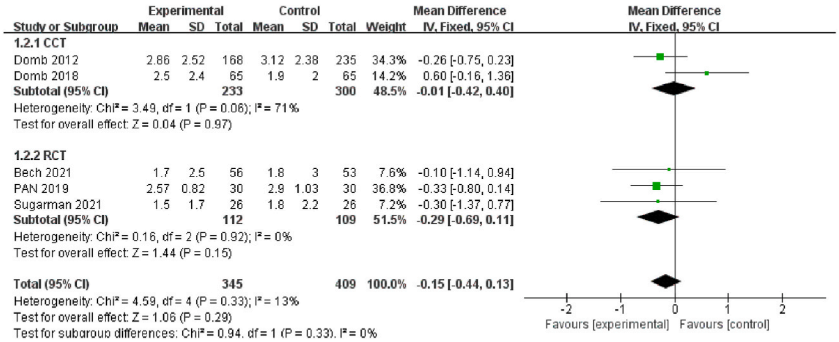


**Fig. 7.** Meta-analysis result of VAS.

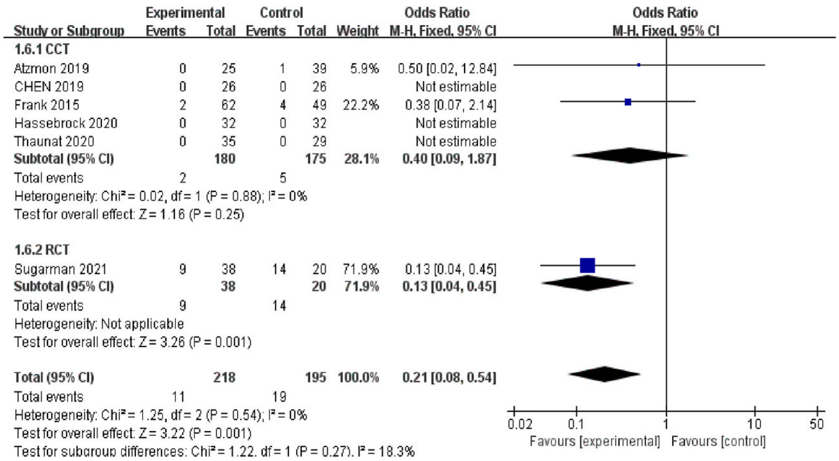


**Fig. 8.** Meta-analysis result of complication rate.

group. As shown in Fig. 9. The findings demonstrated that there was no discernible variation in these two groups' revision rates. ($P$ = 0.19, OR = 0.76, 95 % CI [0.50, 1.15], $I^2$ = 0 %).

## *5.7. Conversion to THA*

Five studies [6,9,13,15,16] reported the conversion to THA in the capsular closure group and the capsular non-closure group, including 576 patients. Two studies [15,16] reported the incidence of conversion to THA was 0 and unable to perform statistical analysis. As shown in Fig. 10. The results demonstrated that the capsular closed group's rate of conversion to THA was lower than the

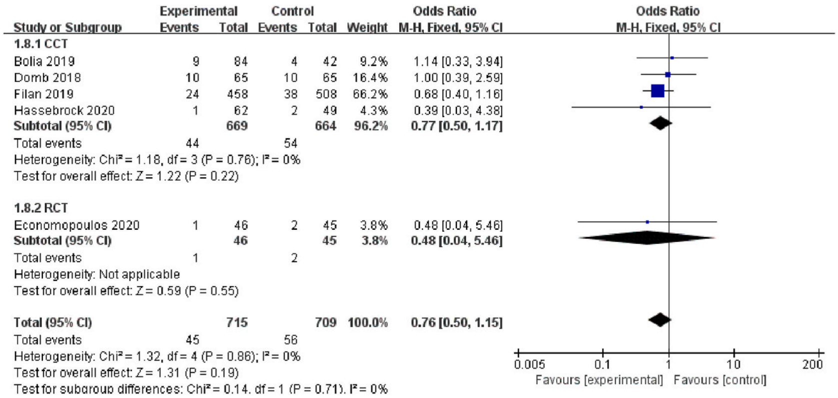


**Fig. 9.** Meta-analysis result of revision rate of hip arthroplasty.

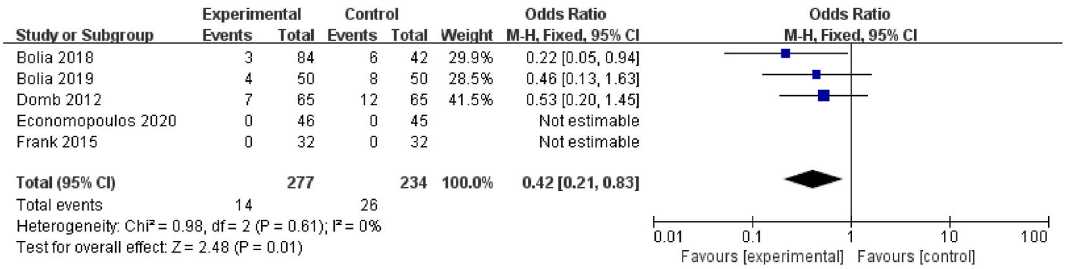


**Fig. 10.** Meta-analysis result of the rate of conversion to THA.

non-closed group's. (OR = 0.42, 95 % CI [0.21, 0.83], $I^2$ = 0 %, $P$ = 0.01).

### 5.8. Funnel plot analysis

Considering that most studies tend to "compare in the postoperative mHHS score between capsule closure and capsule non-closure" as indicators, all of the included studies [6,8,10–12,14–16,18,20] fell in the funnel plot and were relatively evenly distributed on both sides, suggesting a low possibility of publication bias (Fig. 11).

## 6. Discussion

The primary finding of this review is that hip arthroscopy patients with FAI can safely and effectively undergo capsular closure. In comparison to the non-closure capsule, it may lead to better hip function outcomes, a lower complication, and conversion to THA rate, with the caveat that surgery takes more time. In light of the increasing number of hip arthroscopes, it is no longer a major challenge for hip arthroscopic surgeons to perform hip arthroscopic sutures under full scope according to the learning curve principle. A growing number of people are capable of suturing the hip joint capsule rapidly and effectively under full scope. Increasingly, routine suturing of the hip joint capsule under hip arthroscopy has begun to receive attention in recent years and doing so does not significantly increase surgery time and risk.

Based on cadaveric studies [21–23], Our hypothesis was that capsule closure more closely resembled the anatomical and biomechanical features of a normal hip, thus leading to improved function and patient satisfaction. Especially in athletes, who are part of a population with high demand, subtle variations in iomechanics may be more noticeable, therefore preventing them from being able to play at the highest level again [17,24]. Looney et al. [25] have reviewed 5132 hip arthroscopic surgeries, of which 3427 have received capsular closure, while 1705 have not. Clinical comparisons have revealed that the joint capsule closure group outperformed the non-closure group. After a T-capsule incision, the clinical results of complete and partial healing have been compared by Frank et al. [8]. In both groups, there were thirty-two patients, and the mean follow-up was two and a half years. At the final follow-up, the motor performance and patient satisfaction rate in the treatment group were higher than those in the control group. Domb et al. [10] have investigated the impact of joint capsule suture on mid-term follow-up after hip arthroscopy. The findings have demonstrated that postoperative self-scores for patients in both groups were statistically higher than preoperative ones. The postoperative mHHS score and satisfaction in the control group, however, were lower than those in the two-year follow-up ($P$ = 0.05). Furthermore, after the 5-year follow-up, more patients in the control group (18.5 %) than in the treatment group (10.5 %) have required joint arthroplasty surgery. Domb et al. [10]. have stressed that, although the closure of the capsule did not affect the short-term follow-up results, the

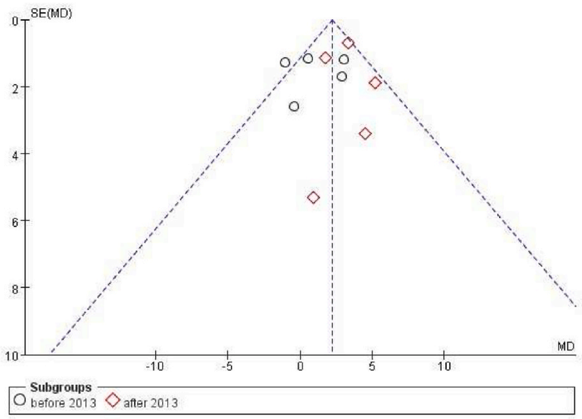


**Fig. 11.** Funnel plot of subgroup analysis.

clinical performance of the capsule closure was superior to that of the non-closure at the mid-term follow-up. Consequently, capsule closure is more advised. Accurate suturing of the capsule during an arthroscopic surgery takes extra time, especially for junior doctors. However, there is no increase in the incidence of postoperative complications as a result of this procedure. The following are the most likely causes: 1) Since the hip joint traction was removed after the management of intracapsular lesions, the procedure of suturing the joint capsule did not extend the total traction time, which was crucial for preventing postoperative complications like transient paresthesia and abnormal urine and feces caused by prolonged traction [26,27]. 2) There is no risk to the blood vessels and nerves surrounding the hip joint when the capsule is sutured side by side in the field of vision [28]. The possibility of unintentional soft tissue damage can be minimized by a skilled surgeon who undergoes professional hip arthroscopic suture training.

The incidence of conversion to HKA during long-term follow-up is lower in patients with capsule sutures [8,15–17]. Research by Frank et al. [8] has demonstrated that compared to the treatment group, the control group had a worse patient-reported outcomes and higher rate of revision. It is reasonable to speculate that arthroscopic incision of the joint capsule without suture is more likely to result in hip microinstability, thereby accelerating the progression of hip osteoarthritis and ultimately leading to the occurrence of THA [29]. According to biomechanical research, capsules are crucial for maintaining hip stability, and closing a capsule improves hip kinematic recovery over leaving it unattended [22,29–31]. For this to be validated, a longer follow-up in clinical research is needed.

Although based on current clinical evidence, it is recommended to perform routine total endoscopic suturing of the hip joint capsule, this procedure still has relative indications and advantages, as well as relative contraindications and shortcomings. Based on the literature included, the specific pros and cons of conventional hip joint capsule suturing are summarized in Table 4.

## 7. Limitations

Several limitations have been identified in this study, including the following: (i) It limited its database searches to Chinese and English, leaving out papers published in other languages and making them inaccessible; (ii) The methodological quality evaluation's risks are not well understood, and the overall quality of the included literature varies, which could affect the systematic review's research findings; (iii) several capsulotomy for hip access have been published (periportal, limited or extended interportal, T-

**Table 4**
The specific pros and cons of conventional hip joint capsule suturing.

| |
|---|
| **Advantages**> |
| 1. Avoid iatrogenic instability. Cases of significant damage to the hip joint capsule and expected difficulty in self-repair caused by interportal capsulotomy or T-shaped capsulotomy. Failure to reconstruct the hip joint capsule poses a risk of iatrogenic instability after hip surgery. |
| 2. Complete closure of the joint capsule can restore the anatomic and physiological functions of capsule and is conducive to rebuilding the dynamic and hip static stability. |
| 3. Protect intra-articular substance integrity from the extracapsular environment. Some cases require transplantation within the hip joint capsule, such as hip joint reconstruction or intra-articular injection of PRP for treatment. Thorough closure of the joint capsule is beneficial for intracapsular transplantation to avoid interference from the extracellular environment. |
| 4. Repairing the capsule may offer greater protection against symptoms resulting from a high risk of hip instability or adhesion development, such as critical hip dysplasia, multiple ligament laxity, female, young athletes, functional impairment, or injury of the round ligament. |
| **Disadvantages and shortcomings** |
| 1. Longer surgical time. Capsular repair is a technically complex part of hip arthroscopy that has been demonstrated to need a longer learning curve. As a result, young surgeons require longer surgical time, which prolongs intraoperative traction time and raises the risk of postoperative complications, such as transient perineal and lower limb numbness. |
| 2. Higher incidence of accidental injuries to the surrounding blood vessels and nerves. Suturing of the hip joint capsule requires operation under hip arthroscopy, and lack of experience can easily cause accidental damage to the surrounding blood vessels and nerves. |
| 3. Higher incidence of postoperative stiffness. An overconstrained joint with limited internal rotation is the consequence of overrepairing the capsule. This may reduce the postoperative hip joint function score and increase the difficulty of postoperative rehabilitation exercises. |

capsulotomy), resulting in statistically different among the patients without closure of the capsule, which is a serious limitation of the study; (iv) there are a lot of variations in the patient selection (age, BMI), surgical procedures (labral management, capsulotomy procedure, capsular repair, and acetabuloplasty or femoroplasty quality), as well as the outcomes following hip arthroscopy. A greater number of studies will be conducted on this topic in the future, and the findings will become more persuasive.

## 8. Conclusion

In conclusion, through meta-analysis, we concluded that the closed group's score in postoperative HOS-ADL, mHHS, and HOS-SSS was considerably higher than the non-closed capsule group's. However, The revision rate and postoperative VAS did not significantly differ between two groups. Although the capsular closure group had a longer surgery time, their conversion to THA was significantly lower than the non-closure group. According to the current meta-analysis, hip arthroscopy with closed capsule may have a higher postoperative functional score than one without a closed capsule.

## Data availability statement

The study's supporting data are publicly accessible at PROSPERO under CRD42022374823.

## CRediT authorship contribution statement

**Yang Lv:** Writing – review & editing, Writing – original draft, Project administration, Methodology, Formal analysis. **Meiping Yang:** Writing – review & editing, Writing – original draft, Formal analysis, Data curation. **Cheng Hu:** Writing – original draft, Software, Methodology. **Da Guo:** Supervision, Software, Project administration. **Caiqiong Zhao:** Software, Investigation, Formal analysis, Data curation. **Li Wei:** Formal analysis, Data curation, Conceptualization. **Shuchai Xu:** Visualization, Validation, Supervision, Project administration. **Dingkun Lin:** Visualization, Validation, Supervision, Project administration. **Weiming Yang:** Writing – review & editing, Writing – original draft, Visualization, Validation, Supervision, Project administration, Data curation, Conceptualization.

## Declaration of competing interest

The authors report the following potential conflicts of interest or sources of funding: This study was supported by the Project of Guangzhou Basic and Applied Basic Research Foundation (No. 2023A03J0749). The authors declare that they have no other known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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